

The documentation and process conversion measures necessary to comply with this revision shall be completed by 11 January 2002.

INCH-POUND

MIL-PRF-19500/431C
11 October 2001
SUPERSEDING
MIL-PRF-19500/431B
16 July 1999

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT TRANSISTORS, N-CHANNEL, SILICON
TYPES 2N4091, 2N4092, 2N4093, 2N4091UB, 2N4092UB, AND 2N4093UB
JAN, JANTX, AND JANTXV

This specification is approved for use by all Departments
and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for N-channel, junction, silicon field-effect transistors intended for use in chopper and analog gate circuit applications. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (similar to TO-18) and figure 2 (UB devices).

1.3 Maximum ratings. $T_A = +25^{\circ}\text{C}$, unless otherwise specified.

Type	P_T (1) $T_A = +25^{\circ}\text{C}$ (free air)	V_{DS}	V_{DG}	V_{GS}	I_G	T_J	T_{STG}
	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>mA d</u>	<u>$^{\circ}\text{C}$</u>	<u>$^{\circ}\text{C}$</u>
2N4091, UB	0.36	40	40	-40	10	-65 to +175	-65 to +200
2N4092, UB	0.36	40	40	-40	10	-65 to +175	-65 to +200
2N4093, UB	0.36	40	40	-40	10	-65 to +175	-65 to +200

(1) Derate linearly 2.4 mW/ $^{\circ}\text{C}$ for $T_A > +25^{\circ}\text{C}$.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Primary electrical characteristics. $T_C = +25^{\circ}\text{C}$, unless otherwise specified.

Type	$r_{ds(on)}$ $V_{GS} = 0$ $I_D = 0$ $f = 1 \text{ kHz}$		$V_{GS(off)}$ $V_{DS} = 20 \text{ V dc}$ $I_D = 1.0 \text{ nA}$		Max I_{DSS} (1) $V_{GS} = 0 \text{ V}$ $V_{DS} = 20 \text{ V dc}$		$V_{DS(on)}$ maximum		
	Ω		V dc		mA dc		$I_D = 6.6 \text{ mA}$ $V_{GS} = 0$	$I_D = 4.0 \text{ mA}$ $V_{GS} = 0$	$I_D = 2.5 \text{ mA}$ $V_{GS} = 0$
	Min	Max	Min	Max	Min	Max	V dc	V dc	V dc
2N4091, UB		30	-5	-10	30		.20		
2N4092, UB		50	-2	-7	15			.20	
2N4093, UB		80	-1	-5	8				.20

(1) Pulsed (see 4.5.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

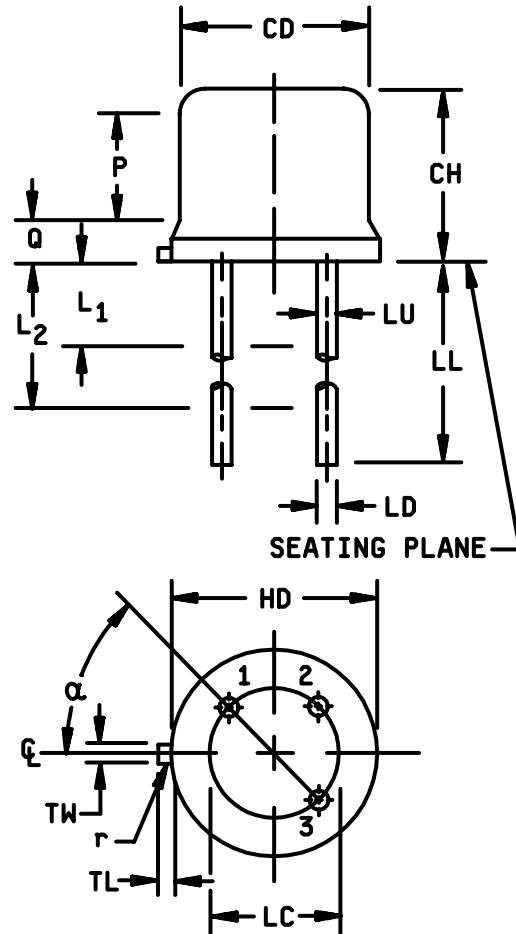
DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

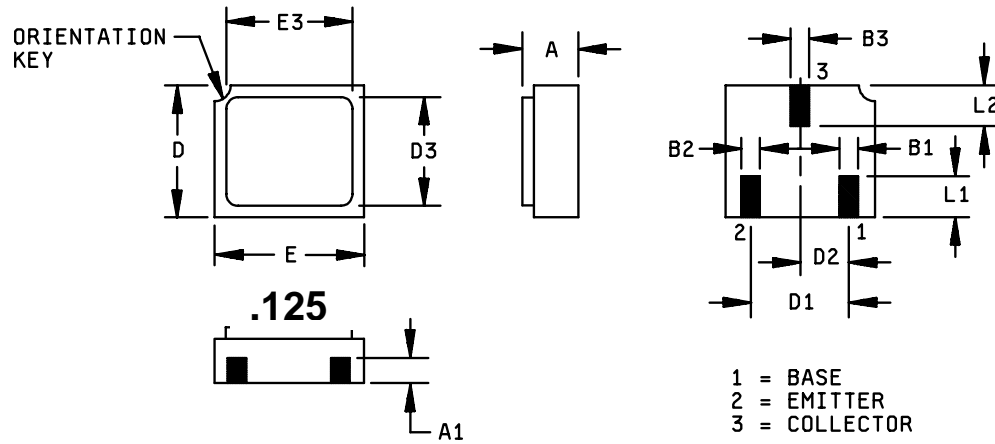
Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.170	.210	4.32	5.33	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		6
LD	.016	.021	0.41	0.53	7,8
LL	.500	.750	12.7 0	19.05	7,8
LU	.016	.019	0.41	0.48	7,8
L1		.050		1.27	7,8
L2	.250		6.35		7,8
Q		.030		0.76	5
TL	.028	.048	0.71	1.22	3,4
TW	.036	.046	0.91	1.17	3
r		.010		0.25	10
α	45° TP		45° TP		6



NOTES:

1. Dimension are in inches.
2. Metric equivalents are given for general information only.
3. Beyond r (radius) maximum, TL shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC.
7. Dimension LU applies between L₁ and L₂. Dimension LD applies between L₂ and LL minimum. Diameter is uncontrolled in L₁ and beyond LL minimum.
8. All three leads.
9. The collector shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.
12. Lead 1 = source, lead 2 = drain, lead 3 = gate.

FIGURE 1. Physical dimensions (similar to TO-18).



Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.046	.056	0.97	1.42	
A1	.017	.035	0.43	0.89	
B1	.016	.024	0.41	0.61	
B2	.016	.024	0.41	0.61	
B3	.016	.024	0.41	0.61	
D	.085	.108	2.41	2.74	
D1	.071	.079	1.81	2.01	
D2	.035	.039	0.89	0.99	
D3	.085	.108	2.41	2.74	
E	.115	.128	2.82	3.25	
E3		.128		3.25	
L1	.022	.038	0.56	0.96	
L2	.022	.038	0.56	0.96	

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

FIGURE 2. Physical dimensions, surface mount (UB version).

3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified MIL-PRF-19500, and figures 1 (similar to TO-18) and figure 2 (UB devices).

3.4.1 Lead material and finish. Lead finish shall be in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead material is desired, it shall be specified in the acquisition document (see 6.2).

3.4.2 Internal construction. Multiple chip construction is not permitted to meet the requirements of this specification.

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.6 Electrostatic discharge protection. The devices covered by this specification require electrostatic protection.

3.6.1 Handling. Devices must be handled with certain precautions to avoid damage due to the accumulation of electrostatic charge. The following handling practices shall be followed:

- a. Devices shall be handled on benches with conductive handling devices.
- b. Ground test equipment, tools, and personnel handling devices.
- c. Do not handle devices by the leads.
- d. Store devices in conductive foam or carriers.
- e. Avoid use of plastic, rubber, or silk in areas.
- f. Maintain relative humidity above 50 percent if practical.
- g. Care shall be exercised, during test and troubleshooting, to apply not more than maximum rated voltage to any lead.
- h. Gate must be terminated to source, $R \leq 100 \text{ k}$, whenever bias voltage is to be applied drain to source.

3.7 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3.

3.9 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4 and tables I, II and III).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.3 Screening (JANTX and JANTXV levels only). Screening shall be in accordance with table II of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table III herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
9 , 10	Not applicable
11	I_{GSS1} , I_{DSS} , $r_{DS(on)}$
12	Method 1039 of MIL-STD-750, test condition A.
13	Subgroup 2 of table I herein; $\Delta I_{GSS} = \pm 50$ pA dc or ± 100 percent of initial value, whichever is greater. $\Delta r_{DS(on)} = \pm 20$ percent of initial value. $\Delta I_{DSS} = \pm 20$ percent of initial value.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in tables VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and paragraph 4.4.2.1 herein. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein.

4.4.2.1 Group B inspection table VIb, JAN, JANTX, and JANTXV of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	1051	Test condition G.
B3	1027	Condition A, $T_A = +175^\circ\text{C}$; $V_{DS} = 0$; $V_{GS} = -24$ V dc, 340 hrs.
B6	1031	$T_{STG} = +200^\circ\text{C}$.

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4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E.
C6	1026	$V_{GS} = -24 \text{ V dc}$; $V_{DS} = 0$; $T_J = +175^\circ\text{C}$.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

TABLE I. Group A inspection.

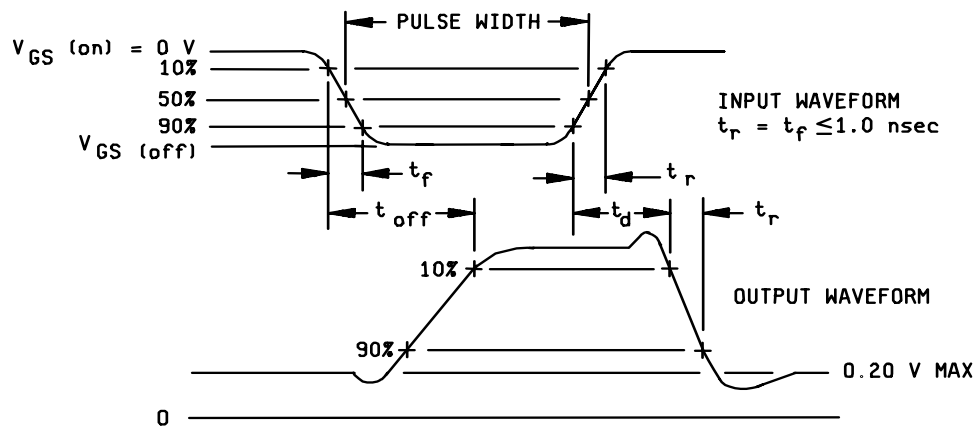
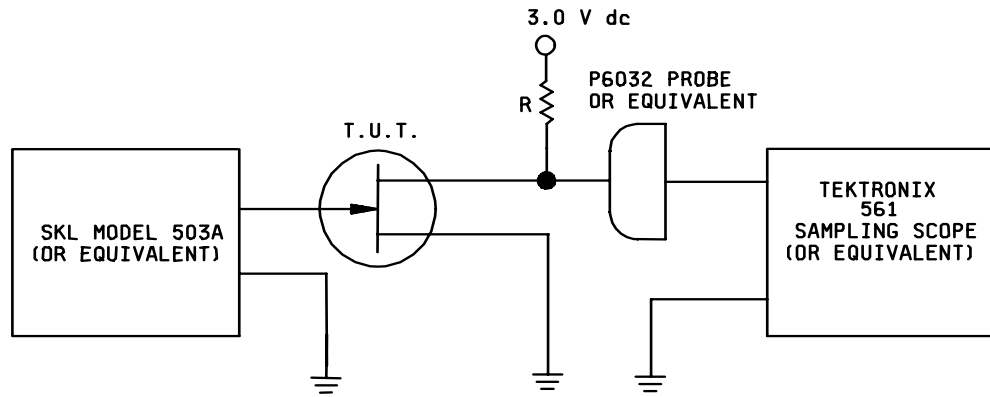
Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Breakdown voltage, gate to source	3401	Bias condition C; $V_{DS} = 0$ V dc; $I_G = -1.0$ μ A dc	$V_{(BR)GSS}$	-40		V dc
Gate reverse current	3411	$V_{GS} = -20$ V dc; $V_{DS} = 0$; bias condition C	I_{GSS}		-0.1	nA dc
Drain current	3413	$V_{DS} = 20$ V dc; bias condition C	$I_{D(off)}$		-0.1	nA dc
2N4091, UB		$V_{GS} = -12$ V dc				
2N4092, UB		$V_{GS} = -8$ V dc				
2N4093, UB		$V_{GS} = -6$ V dc				
Drain current	3413	$V_{DS} = 20$ V dc; $V_{GS} = 0$ (pulsed, see 4.5.1); bias condition C	I_{DSS}			
2N4091, UB				30		mA dc
2N4092, UB				15		mA dc
2N4093, UB				8		mA dc
Static drain to source on-state resistance	3421	$V_{GS} = 0$; pulsed (see 4.5.1); bias condition B; $I_D = 1.0$ mA dc	$r_{DS(on)}$			
2N4091, UB					30	ohms
2N4092, UB					50	ohms
2N4093, UB					80	ohms
Drain to source "on" state voltage	3405	$V_{GS} = 0$; bias condition B	$V_{DS(on)}$			
2N4091, UB		$I_D = 6.6$ mA dc			0.2	V dc
2N4092, UB		$I_D = 4.0$ mA dc			0.2	V dc
2N4093, UB		$I_D = 2.5$ mA dc			0.2	V dc

See footnotes at end of table.

TABLE I. Group A inspection - continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 3</u>						
High temperature operation:		T _A = +150°C				
Gate current	3411	Bias condition C; V _{DS} = 0 V dc V _{GS} = -20 V dc;	I _{GSS}		-0.2	μA dc
Drain current	3413	V _{DS} = 20 V dc; bias condition A	I _{D(off)}			
2N4091, UB		V _{GS} = -12 V dc			0.2	μA dc
2N4092, UB		V _{GS} = -8 V dc			0.2	μA dc
2N4093, UB		V _{GS} = -6 V dc			0.2	μA dc
<u>Subgroup 4</u>						
Small-signal common-source short-circuit input capacitance	3431	V _{DS} = 20 V dc; V _{GS} = 0; f = 1 MHz	C _{iss}		16	pF
Small-signal common-source reverse transfer capacitance	3433	V _{DS} = 0 V dc; V _{GS} = 20; f = 1 MHz	C _{rss}		5	pF
Turn-on delay time		See figure 3	t _{d(on)}			
2N4091, UB					15	nS
2N4092, UB					15	nS
2N4093, UB					15	nS
Rise time		See figure 3	t _r			
2N4091, UB					10	nS
2N4092, UB					20	nS
2N4093, UB					40	nS
Turn-off delay time		See figure 3	t _{d(off)}			
2N4091, UB					40	nS
2N4092, UB					60	nS
2N4093, UB					80	nS
<u>Subgroups 5, 6, 7</u>						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.



NOTES:

1. Measure under pulse conditions: Pulse width ≤ 300 ms; duty cycle ± 3 percent.
2. 2N4091, $I_D = 6.6$ mA.
2N4092, $I_D = 4.0$ mA.
2N4093, $I_D = 2.5$ mA.
3. 2N4091, $I_{GS(off)} = -12$ V.
2N4092, $I_{GS(off)} = -8.0$ V.
2N4093, $I_{GS(off)} = -6.0$ V.

FIGURE 3. Switching time test circuit and waveforms.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. The lead finish as specified (see 3.4.1).
- d. Type designation and quality assurance level.
- e. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturer's List (QML) No.19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from, Defense Supply Center Columbus, ATTN: DSCC-VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Army -CR
Navy -NW
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2480)

Review activities:
Air Force - 19, 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-PRF-19500/431C

2. DOCUMENT DATE
011011

3. DOCUMENT TITLE

SEMICONDUCTOR DEVICE, FIELD EFFECT TRANSISTORS, N-CHANNEL, SILICON TYPES 2N4091, 2N4092, 2N4093, 2N4091UB, 2N4092UB, AND 2N4093UB JAN, JANTX, AND JANTXV

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)
COMMERCIAL
DSN
FAX
EMAIL

7. DATE SUBMITTED

8. PREPARING ACTIVITY

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